DOCUMENT RESUME

ED 133 154 SE 021 469

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TITLE	Exponential Explosions! Today.... Tomorrow.... ? [Project ECOLogy ELE Pak, Jensen Pak].
INSTITUTION	Highline Public Schools, Seattle, Wash.
SPONS AGENCY	Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D.C.
PUB DATE	[76]
NOTE	41p.; For related documents, see SE 021 438-478; Not available in hard copy due to marginal legibility of original document
AVAILABLE FROM	Highline Public Schools, Instructional Division, Project ECOLogy ESEA Title III, Bill Guise, Director, 15675 Ambaum Blvd., S.W., Seattle, WA 98166 ($2.50)
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Environment; Environmental Education; *Instructional Materials; Mathematics; *Mathematics Education; Pollution; Population Growth; *Secondary Education; *Secondary School Mathematics; Units of Study (Subject Fields)
IDENTIFIERS	Elementary Secondary Education Act Title III; ESEA Title III; *Exponents

ABSTRACT

This is one of a series of units for environmental education developed by the Highline Public Schools. The unit is designed for junior high school mathematics classes and emphasizes applications of exponents to problems of population growth and pollution. The nine lessons are designed for about eleven school days. Each lesson includes the concept of the lesson, materials needed, procedure, evaluation activities, and suggested extra activities. The materials were tried and evaluated; evaluation data may be obtained from the Highline Public Schools. (RH)

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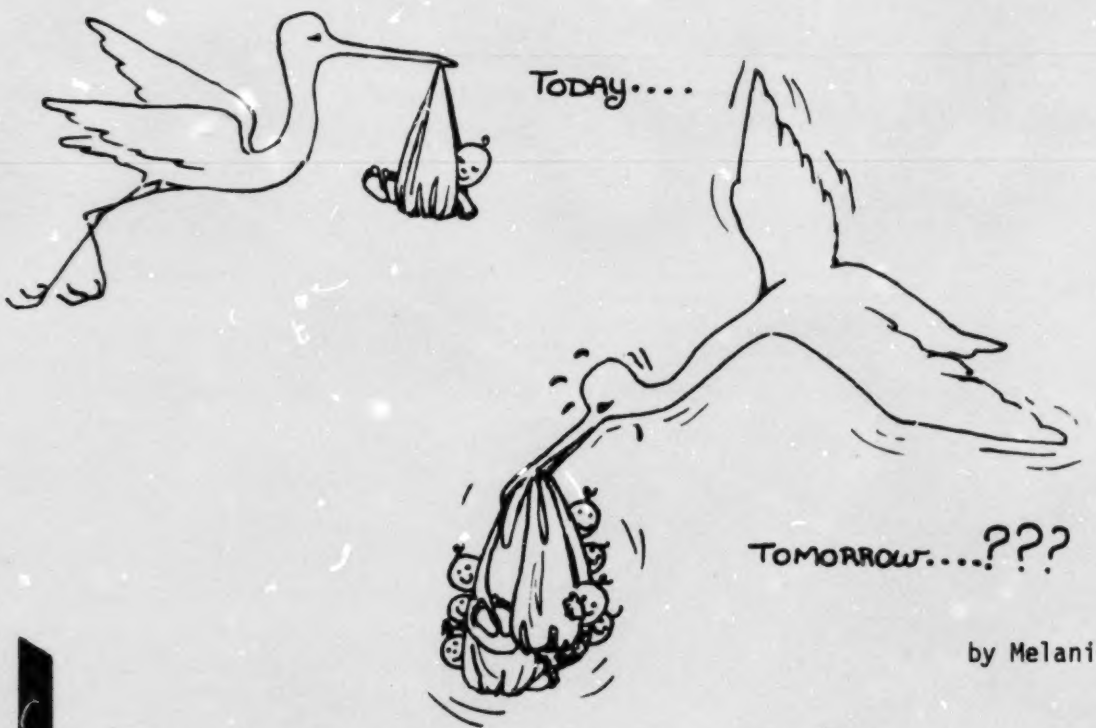
ED133154

JENSEN PAK

EXPONENTIAL EXPLOSIONS!



by Melanie Jensen

An Environmental Learning Experience for 7th grade math class. One of many "ELE PAKS" available for all areas.

Project ECOLogy, Title III, ESEA
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SE 021 469

NATURE KNOWS BEST

PROJECT ECOLOGY TITLE III

The Kids Who Participated in the Pilot Evaluation Program

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Bob Bates	Chris Hawley	Jennifer Parry
Renee Beaver	Jan Hays	Shelly Ruud
Letha Bedard	Ronnie Helms	Jim Smith
Margaret Birch	Dean Hodgins	Jim Umbinetti
Jim Brooks	Katie Hoeft	Milo Undlin
Bernie Burnett	Doug Jacobsen	Mark Vinson
Jeff Campbell	Leslie Kido	Bob Wagner
Tim Conyers	Dale Mauldin	Derrin Walters

The Readers Who Studied, Critiqued & Offered Suggestions & Ideas for Improvement

Vern Johnson, Highline School District
Ron Abramson, Mt. Rainier High School, Math Teacher
Chuck Hardy, Highline School District, Math Coordinator
Dr. Steve Flajser, University of Washington
Chuck Judd, Highline School District
Dick Singletary, Bellevue School District

The Author/Teacher Who Developed This Environmental Learning Experience (ELE)

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Evaluation Results Regarding This ELE May Be Obtained by Including This Page and a Self Addressed Stamped Envelope To

Highline Public Schools, District 401
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Project ECOLogy ESEA Title III
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EVERYTHING IS CONNECTED TO EVERYTHING ELSE

PROJECT ECOLOGY

THERE IS NO SUCH THING AS A FREE LUNCH

PROJECT ECOLOGY TITLE III

EVERYTHING MUST GO SOME WHERE

PROJECT ECOLOGY • TITLE III

MASTER MATERIAL LIST

Overhead projector and marker
Chalk board and chalk
Graph paper for students
Rulers for each student
Film projector
* "A Matter of Time" (25 min.)
"Of Broccoli & Pelicans and Celery & Seals" (30 min.)
"From the Face of the Earth" (13 min.)
Construction paper - large - for each student
Old magazines to be cut up
Scissors for students
Paste
Marking pens
Tagboard 18 x 24/student
3 x 5 cards (5/student)
Scotch tape
Fruit Fly Kit - order from Chuck Hardy, ERAC, 433-2458

* These films are in high demand. I suggest that you order them in August, or at least 3-5 months before the unit. They are very good and add a lot to the unit.

NOTES TO TEACHER

Lessons 1-7 in this unit are planned to take one 50 minute period each. Lessons 8 and 9 should have 2 days per lesson.

All films are available from the film library at the E.R.A.C. Order them early.

What the teacher is to say to the student is written in script.

A number of pages in this unit are designed to be used in making dittos and transparencies for the lessons. These are labelled.

If you should feel the need for some more information as back up, the following book should help: The Limits to Growth - available at the Project ECOLogy office, ERAC, 433-2453.

Any junior high level science book should have lots of information about pollution which would give you background material. Some suggested texts are: (1) Teaching Population Concepts, Pat King/John Lardahl, S.P.I.; (2) Population Education Resources Packet, Zero Population Growth, Inc.; (3) Population Reference Bureau, 1755 Massachusetts Ave. N. W., Washington D.C. 20036.

I tried to employ as much media as possible in this unit without deviating too far from the math theme. Too often mathematics can become non-media oriented. There are lots of projects, usually not associated with the math classroom. I hope your students enjoy them.

CONCEPTUAL OVERVIEW OF UNIT

1. Exponents are mathematical shorthand. Exponential growth when base $>$ 1 means a doubling each time of the new quantity.

2. Pie or circle graphs are used with % to illustrate and compare. Line graphs show exponential growth as an upwards curve.

3. Population growth is exponential. Given a time period, it doubles.

4. Pollution is caused by people. Population grows exponentially, therefore pollution grows exponentially, also. Pollution growth is very fast because the growth is exponential.

5. Water pollutants come from the things we use daily.

6. Pollution hurts others, besides the polluter. Some pollution is invisible.

7. Review of lessons 1-6. Quiz.

8. Construction of a pollution game using pollution and exponent questions reinforces the above concepts.

9. We are responsible for the future. What will it be like?

LESSON 1

CONCEPT: Exponents

MATERIALS: Overhead projector and marker
Chalkboard and chalk
Fruit fly kit
Exponent exercises for each student

PROCEDURE: Day 1

Write the word exponent on the overhead.

What is this word?
Can someone come up and give an example, on the board, of an exponent?
Now that we know what an exponent is, who can show what it does?

Student should show that the exponents tell the number of times a numeral is used as a factor to get a product.

ie: $3^2 = 3 \times 3 = 9$

$4^2 = 4 \times 4 = 16$

$2^4 = 2 \times 2 \times 2 \times 2 = 16$

Introduce or reinforce idea of zero as exponent.

What kind of an answer do we get when we use zero as an exponent?
If students do not know, tell them - *Any number that has an exponent of zero will be equal to one.* Examples on overhead showing various numbers to the zero power all equal to one.

Exponents are much more powerful than most people realize. To show the power of exponents, ask students the following parable about exponential growth. *If you had your choice, which would you take (a) a penny, doubled on each of the 64 squares on a checkerboard or (b) $1,000,000?*

Allow the students rest of class to work on problem.

Day 2

Then show them that a penny doubled on each of 64 squares on a checkerboard would be equivalent to $95,658,249,499,392,430.08. (≈ 100 zillion dollars).

The last exercise we just completed is an example of exponential growth.

See Insert #1 for detailed explanation of how the student could solve 2^{63}.

Set up fruit fly kit - if one was available. See Insert #2.

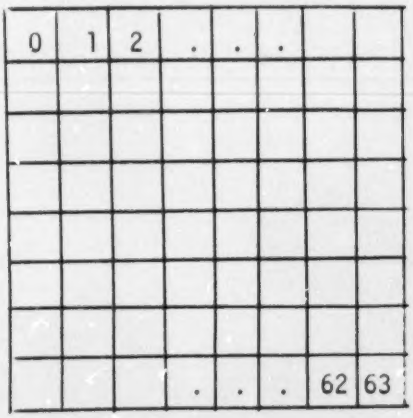
EVALUATIVE ACTIVITY: Give out exponential exercise sheet.

SUGGESTED EXTRA ACTIVITY: Show film "Powers of Ten"

INSERT #1

Since we are doubling the penny, we can use 2 as our base. Looking at a checkerboard we can find a pattern as to what the final exponent will be.

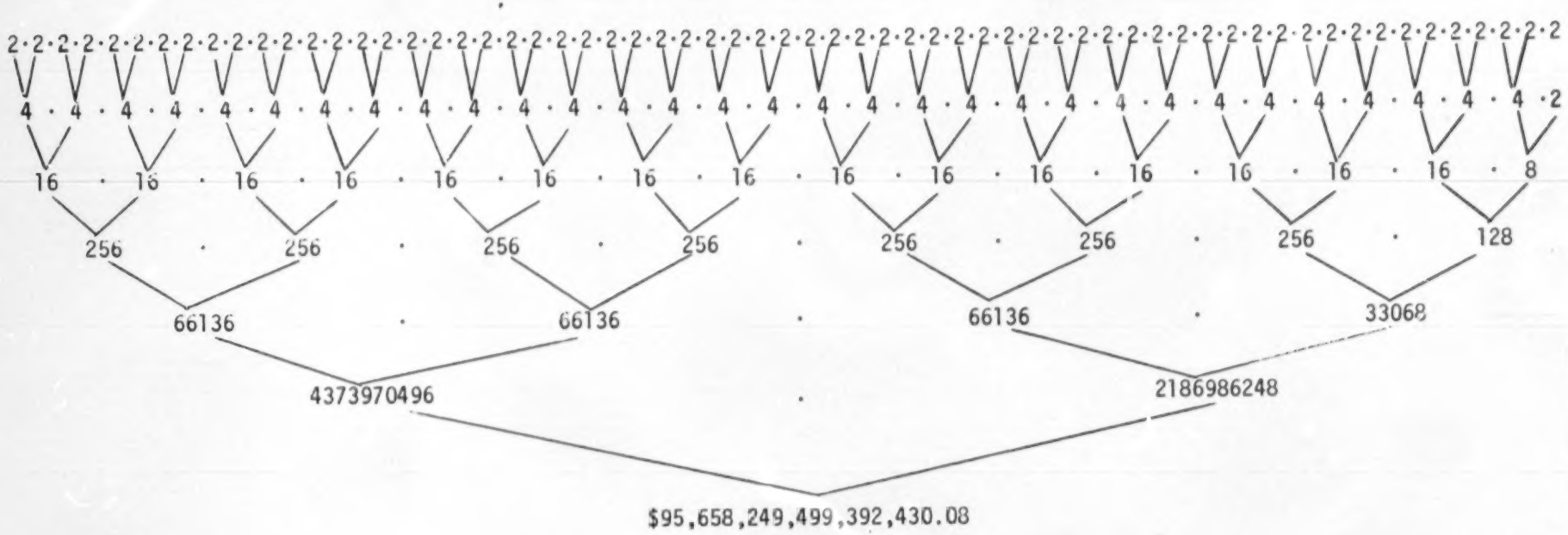
Exponents:



Since there will be 1 penny in the first square, we can have the exponent be 0 since $2^0=1$. The second square will have 2 pennies, therefore the exponent will be 1, because $2^1=2$....$2^2=4$. We find the final exponent will be 63.

We can now use a visual method to find 2^{63}. This means 2, used as a base, 63 times.

INSERT #1 - page 2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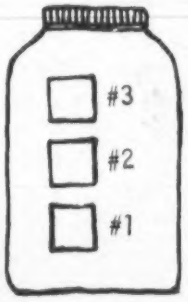
INSERT #2

FRUIT FLY KIT

Follow directions on kit.

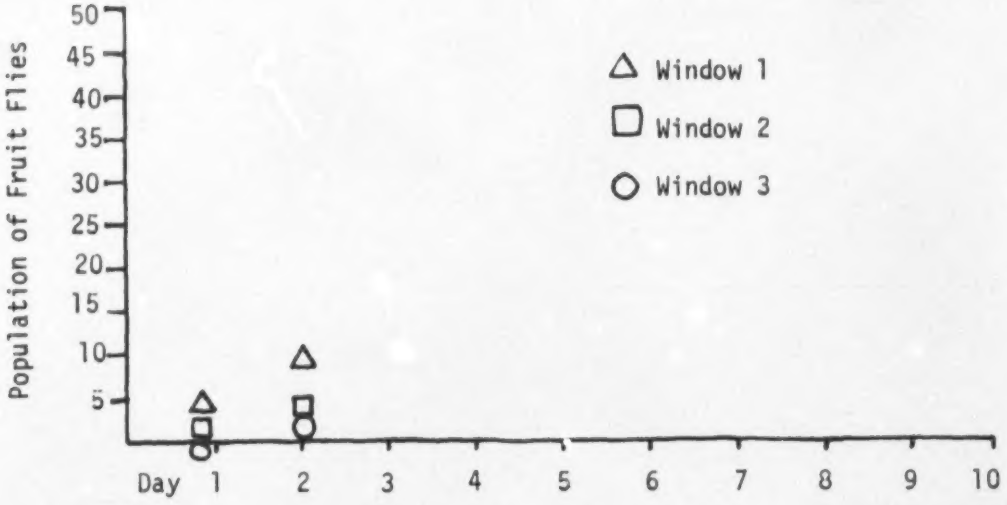


With tape mark off 3 squares 1" x 1" at 3 levels on jar.

Each day of project assign 2-5 students to take a count of fruit flies at each window and average each count. Plot each count on large butcher paper graph, displayed in some area of room.

Example: Day 1:

	Window 1	2	3
Student A	2 flies	0	0
Student B	5 "	1	0
Student C	3 "	0	0
Average	3 1/3	1/3	0



Day 2:

	Window 1	2	3
Student A	5	1	1
Student B	6	3	0
Student C	4	2	1
Student D	8	2	2
Average ≈	6	2	1

LESSON 2

CONCEPT: Review of pie and line graphs.

MATERIALS:
Overhead and marker
Graph paper for each student
A copy of transparency #2A for each student
A copy of exercise #2 for each student

PROCEDURE: Pie graphs - on overhead write the words "Pie Graph" and ask what this term implies.

What does the term "pie" imply? (Possible answers are round, pieces, etc.)

Explanation of pie graph.

Most or all of the pie graphs are in terms of percent. If 100% is the same as all of the pie graph, how much of the graph is 50% 25% (½, ¼)

Put transparency 2A on overhead.

This pie graph shows the types of pollution that are in the air and the concentration of each with respect to the other. What is the most common air pollutant? (Carbon monoxide, 47%)

What is the least common? (Nitric oxides, 10%)

What is the sum of the percents represented by different sections of this pie graph?

Put transparency 2B on overhead.

This pie graph shows us where the different pollutants come from. Where does most of the air pollution come from? (Transportation, 42%)

Where does the least come from? (Solid Waste Disposal, 5%)

Line graphs - Put transparency 2C on overhead.

This is called a line graph. Most line graphs have two scales, vertical and horizontal, one of which is usually some measurement of time. What is the time scale on this graph? (years)

What is the other measurement? (population)

In what year was or might the population be over 4000? (1980)

What do you call the type of information about 1980? (prediction)

We can call this a line extension graph. These graphs should not be used as fact, but to show a possible trend. The predicted part of the graph can be shown by a dotted line.

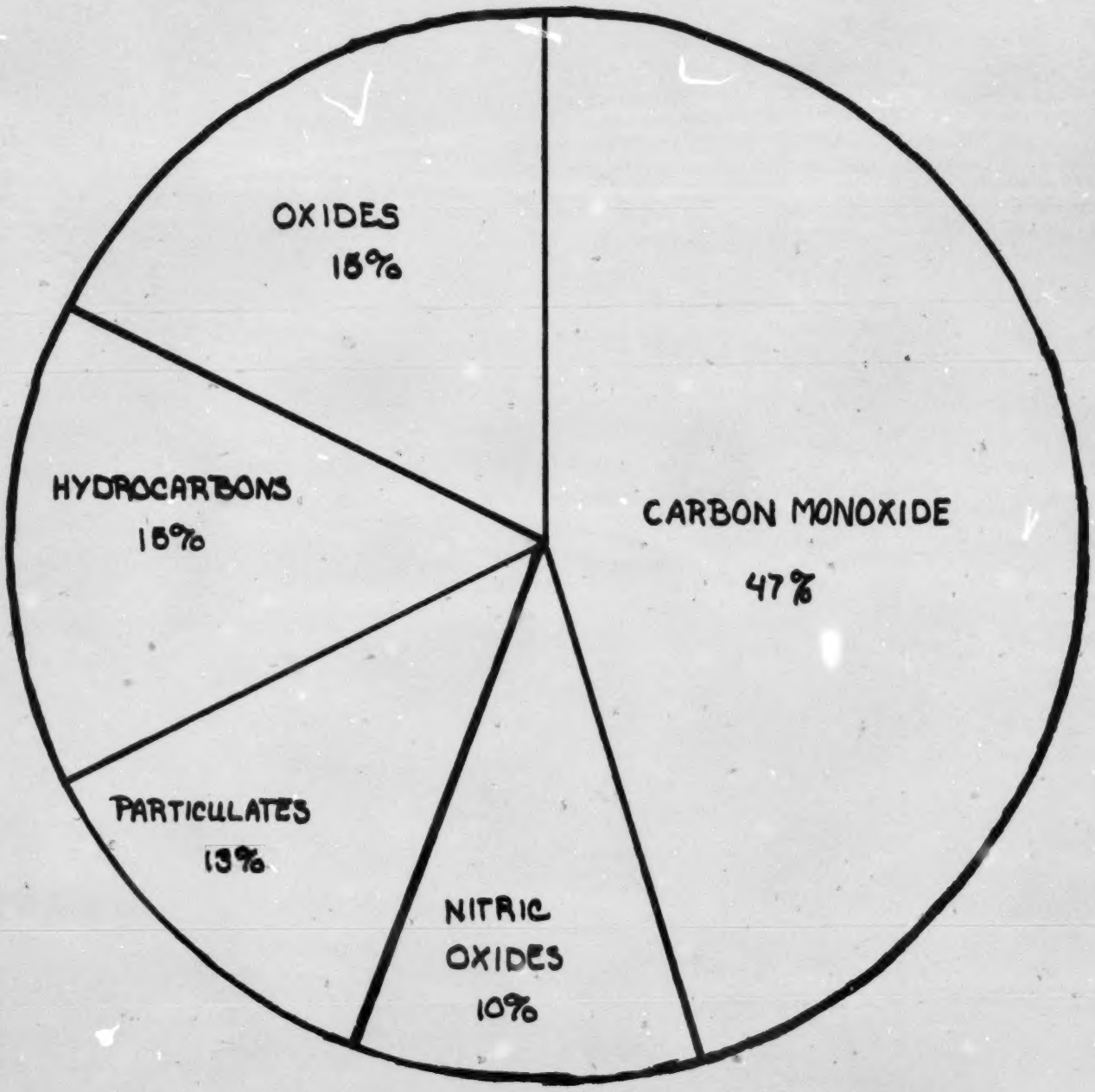
EVALUATIVE ACTIVITIES: Have students answer questions on graph handout.

Have students construct graphs from information on handout.

SUGGESTED EXTRA ACTIVITIES: Have students collect some data on their own and incorporate it into a graph of their own choice.

TRASPARENCY 2A

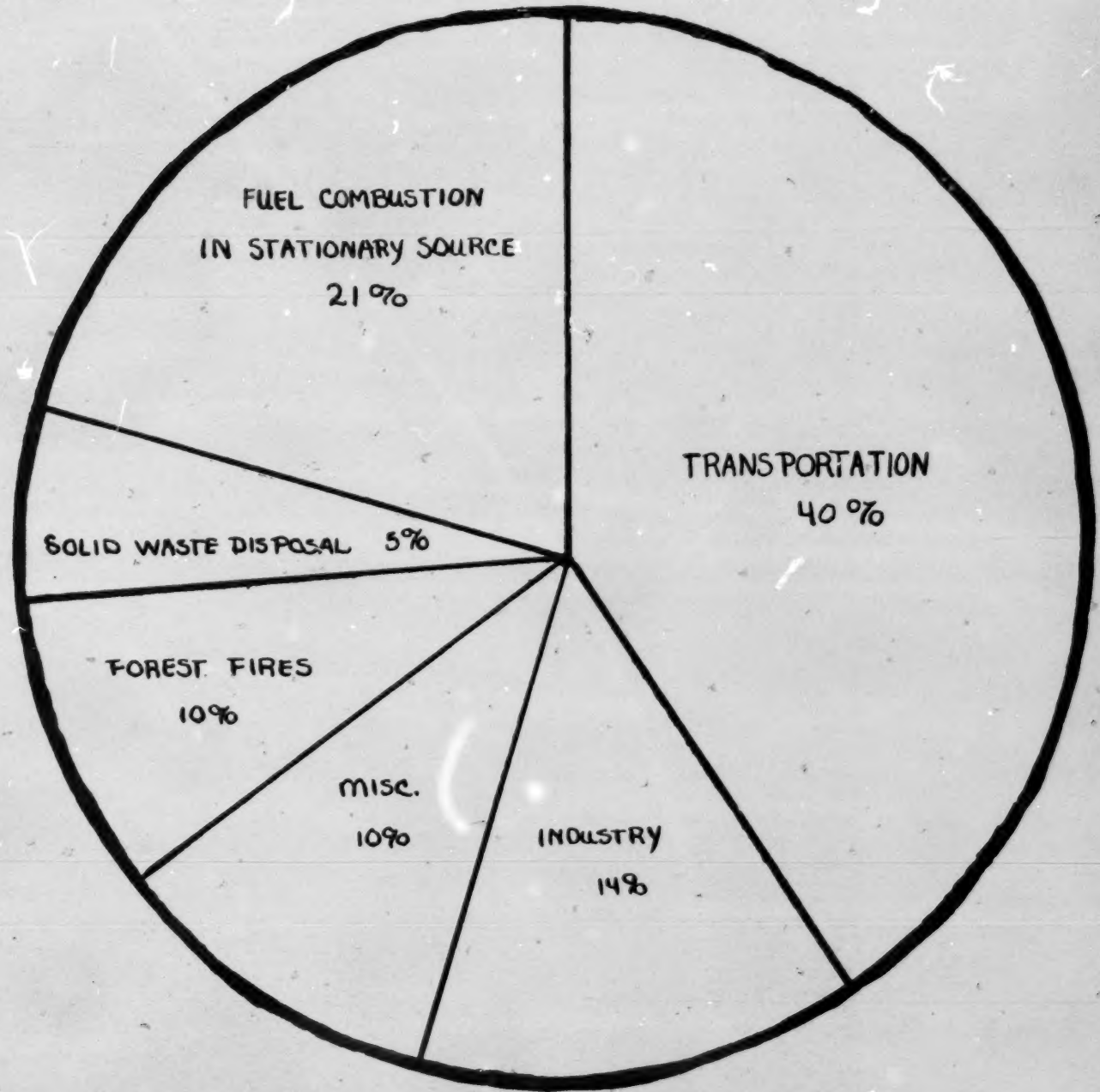
AIR Pollution



RELATIVE AMOUNT OF POLLUTANTS IN THE AIR

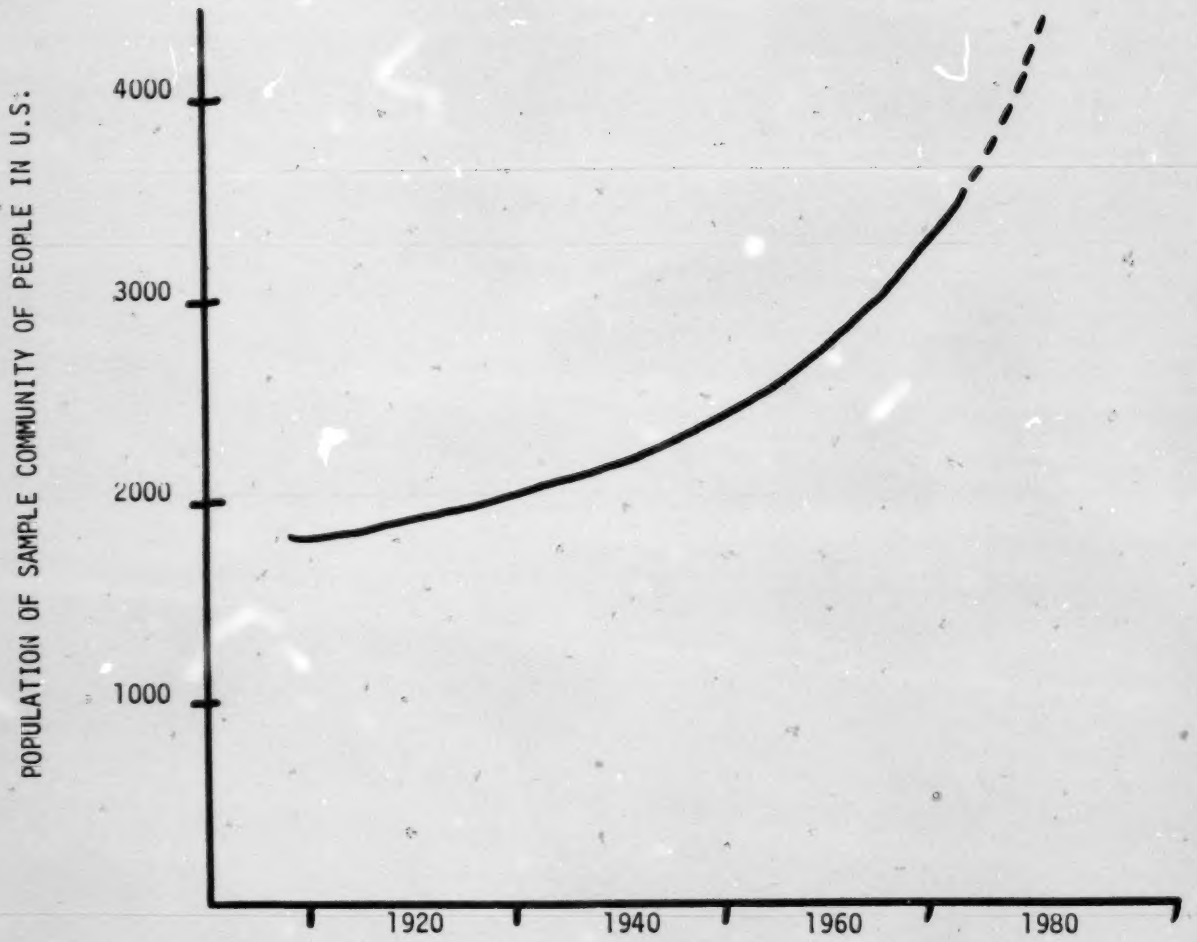
AIR POLLUTION

TRANSPARENCY 2B



SOURCES OF POLLUTANTS

TRANSPARENCY 2C



Graph worksheet for lesson 2.

Name _____ Date _____

Use pie graph to answer these questions.

1. The amount of Carbon Monoxide in the atmosphere is 2 times greater than that of _____ and _____ added together.

2. The pieces of a pie graph always add up to _____%.

3. Which pollutant is second most abundant _____ or _____.

4. Which pollutant is least abundant _____.

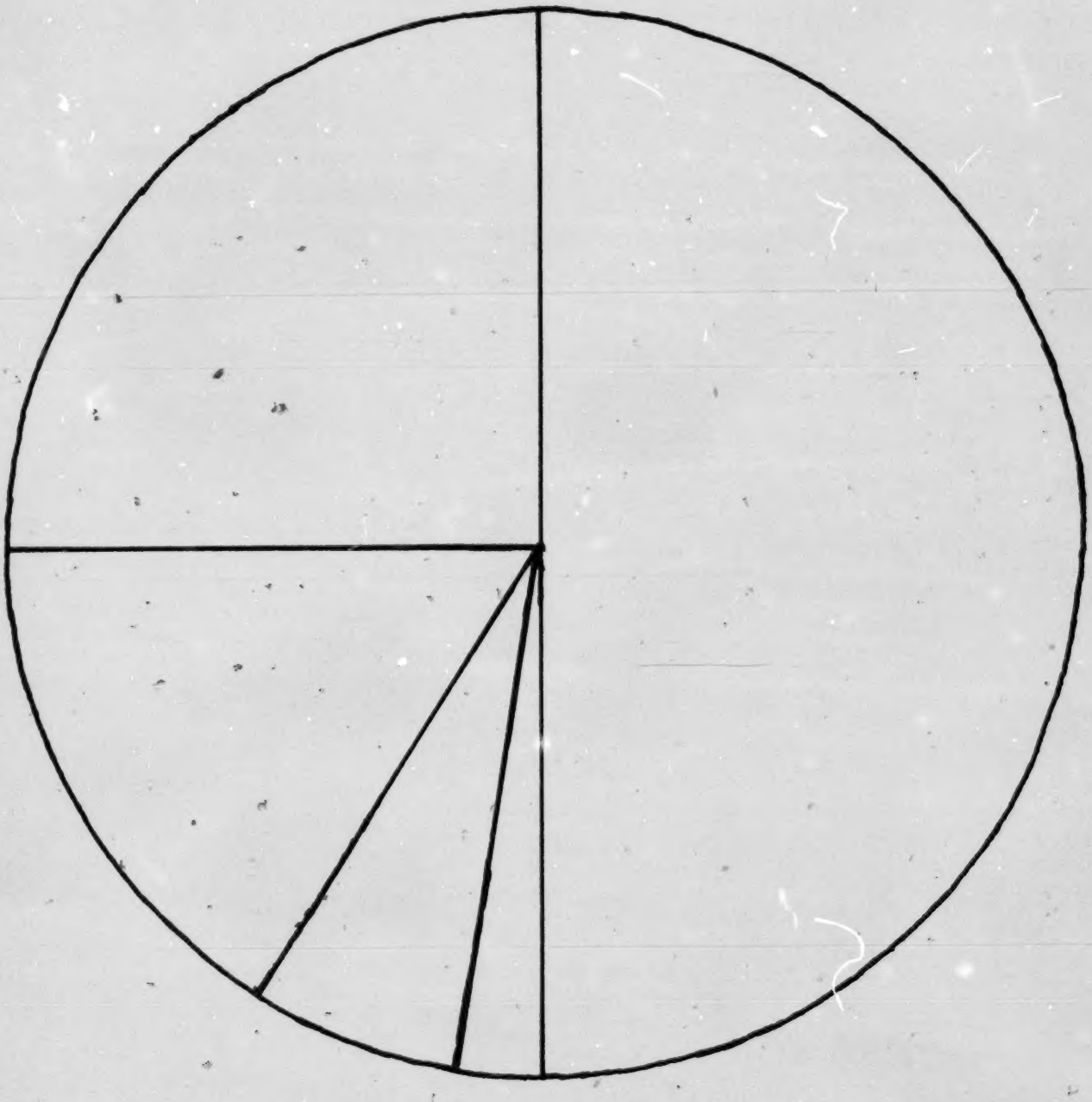
5. What is the sum of the percents the following pollutants represent:

Particulates	_____
Carbon monoxides	_____
Hydro carbons	_____
Total	_____

Use the information below to fill in the empty pie graph. The percents of the pollutants have been changed from those of the previous example.

Oxides	2%	Nitric Oxides	18%
Particulates	50%	Carbon Monoxides	5%
Hydro carbons	25%		

GRAPH WORKSHEET – LESSON 2



LESSON 3

CONCEPT: Population growth is exponential. Given a time period, it doubles.

MATERIALS:
Overhead and marker
Transparency 2C
Transparency 3A
Graph paper and rulers for students

PROCEDURE: Put transparency 2C on overhead. Briefly review previous lesson concerning exponential linear graphs.

What kind of a graph is this? (line)

Look at the population in the year 1920. What is the population? (2000)

In what year will the population be double this amount? (1975)

How long did it take for the population to double? (55 years)

Introduce idea of doubling time.

This 55 years is called the doubling time of this particular population.

Put transparency 3D on overhead. Reinforce idea of doubling time.

Here is another graph of a sample population. This population is also growing exponentially. The graph curves upwards. Let's find the doubling time of our new population.

What was the population on June 20th? (2000)

When did the population reach 4000? (June 21st)

What, then, is the doubling time of this new population? (1 day)

What do you think the population would be on June 23rd? (16,000)

Idea of prediction through use of exponential growth and doubling time.

Now we see that from this graph we can not only find the doubling time, but we can also guess what populations might be at any future time

Let's figure out the population growth of our classroom and what our population might be in the future.

EVALUATIVE ACTIVITY:

Ask students how many children in each family. Determine average number of children per set of two parents. If a generation is given to be twenty years we then compute the doubling time.

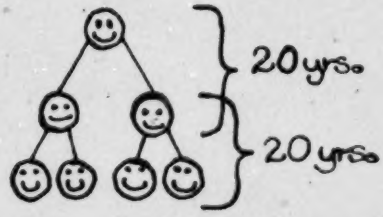
How many children do each of you have in your families? (Answers will vary, have a student writing down the numbers on the board.)

Each student will now do the arithmetic involved in these computations.

Since there are X families involved, divide your sum (S) by X and you will get the average number of children per pair of adults, S ÷ X.

In order to get a number we can use with respect to individuals instead of pairs of parents we are going to divide our number again. What do you think we will divide it by? (Hopefully someone will come up with the number 2, because of 2 parents.)

Now we have the number S ÷ (2X) which will be the average number of children per individual in a 20 year time span. A picture of what might possibly happen if each individual ends up with 2 children per generation would be the graph. On overhead.



Ask: *What will happen in 20 more years?*

This stage will involve the construction of a population graph. Hand out graph paper and rulers to all students.

We're now ready to begin constructing our population graph.

Draw your axis along the bottom and left hand side of the graph paper and leave enough room for labelling.

Teacher should use overhead to help in the construction of graph, going step by step with students.

Labelling.

Along the bottom axis at 10 unit intervals, put a mark and label by 20's i.e.; 20, 40, 60, 80. This represents years.

Along the side axis, in 5 unit intervals label the graph by 1's, i.e.; 1, 2, 3, 4....This represents population.

At zero, when we started counting how many people are we starting with? (1)

What should we mark at 20? (S ÷ (2X))

The next step we take involves the guessing or predicting I was speaking of. If the number of children per family stays the same then in another 20 years we will have $\frac{S}{2X} \cdot \frac{S}{2X}$ *population.*

Compute the value of this, round it off and mark it on your graph. $\frac{S^2}{4X^2}$

What is another way to write $\frac{S}{2X} \cdot \frac{S}{2X}$? (with exponents)

Now we see why it is called exponential growth, we use exponents.

Prediction of future populations by using the exponential curve and also by finding the doubling time.

Your graph should be completed for 5 generations. Once this is completed, we can find our doubling time.

When did the population reach 2? (answers will vary)

How long did it take to reach 2?

What is this length of time called? (doubling time)

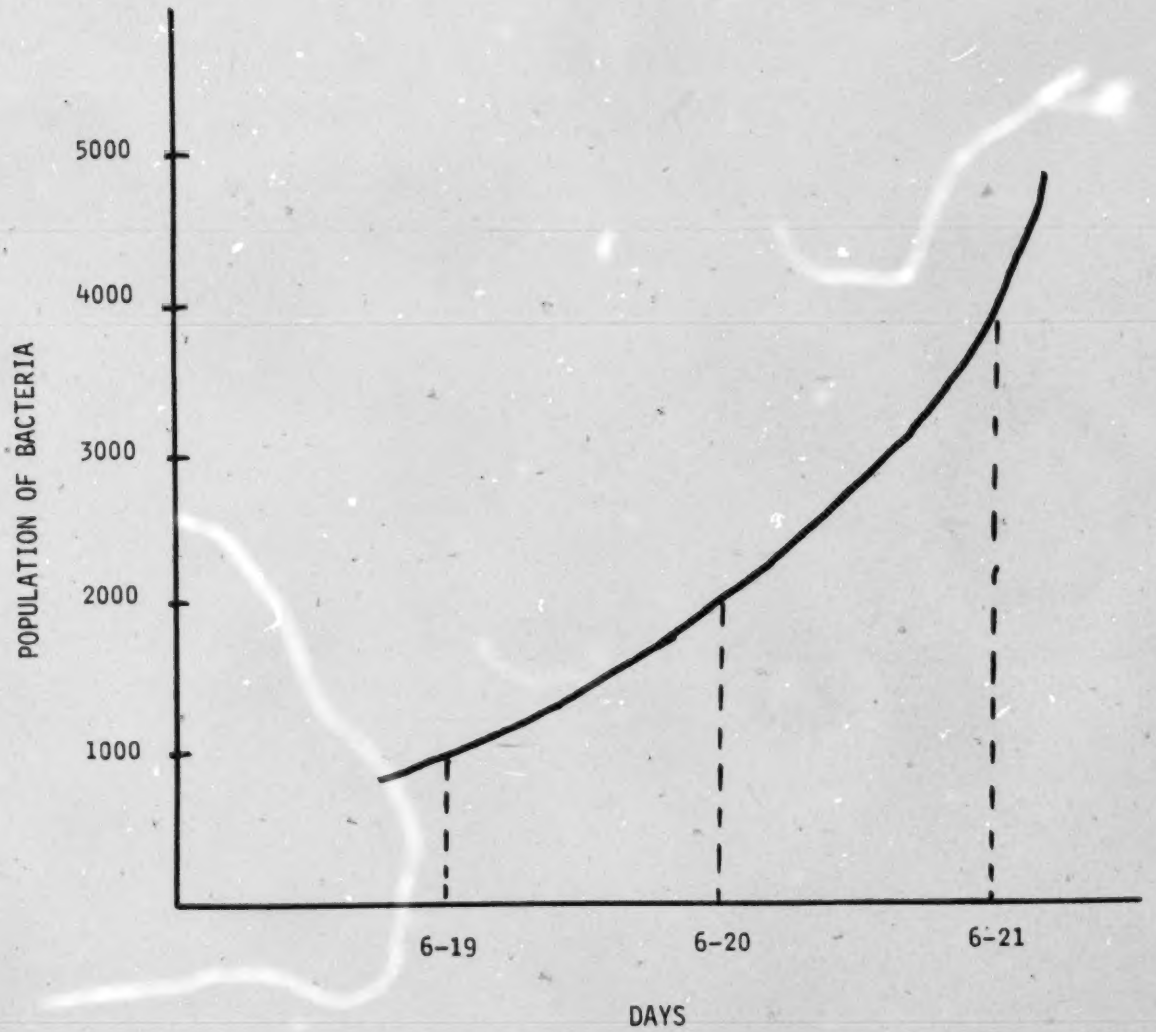
We have been able to calculate the doubling time of a population by knowing its growth rate.

Have students hand in graphs.

POST EXERCISE:

Thought question: How long can exponential growth continue?
Living conditions?
Food?
Clothing?
Housing?
Disease?

TRANSPARENCY 3A



LESSON 4

CONCEPT: Pollution is caused by people. Population grows exponentially, therefore pollution grows exponentially. Pollution growth is very fast because of exponential growth.

MATERIALS:
Overhead and marker
Projector
"A Matter of Time" film (25 min.)
Graph paper for each student
Transparency #4A
Graphs students made for lesson 3.

PROCEDURE: Reinforcement of exponential graphing. Hand back graphs from lesson 3. Review.

The graphs you just got back are those you made in the previous lesson. We learned that population grows which way? (exponentially)

Is exponential growth accelerating or decelerating? (accelerating)

Now we know two things. (1) Populations grow exponentially and (2) Exponential growth is usually accelerating.

What causes pollution? (people)

If the source of pollution grows exponentially, how do you think pollution would have to grow? (exponentially)

Examination of some pollution graphs to illustrate the idea of pollution growing exponentially.

Put transparency 4A on overhead.

This shows us a graph of the amount of pollution present and the manner in which it has increased.

Does it follow the pattern of being an exponential curve? (yes)

What will happen if nothing is done to check the growth of this curve? (Ideas: no more room for people, pollution will choke off all other life, any ideas from students are good.)

Write down above ideas on board.

We are now going to see a film about pollution. Watch it and see if the film will give you any new ideas as to what some of the consequences of unchecked pollution might be.

Show film.

Review of film.

EVALUATIVE ACTIVITIES:

Look at some of the ideas that we wrote on the board before we saw the film. Can you think of any more? What are they?

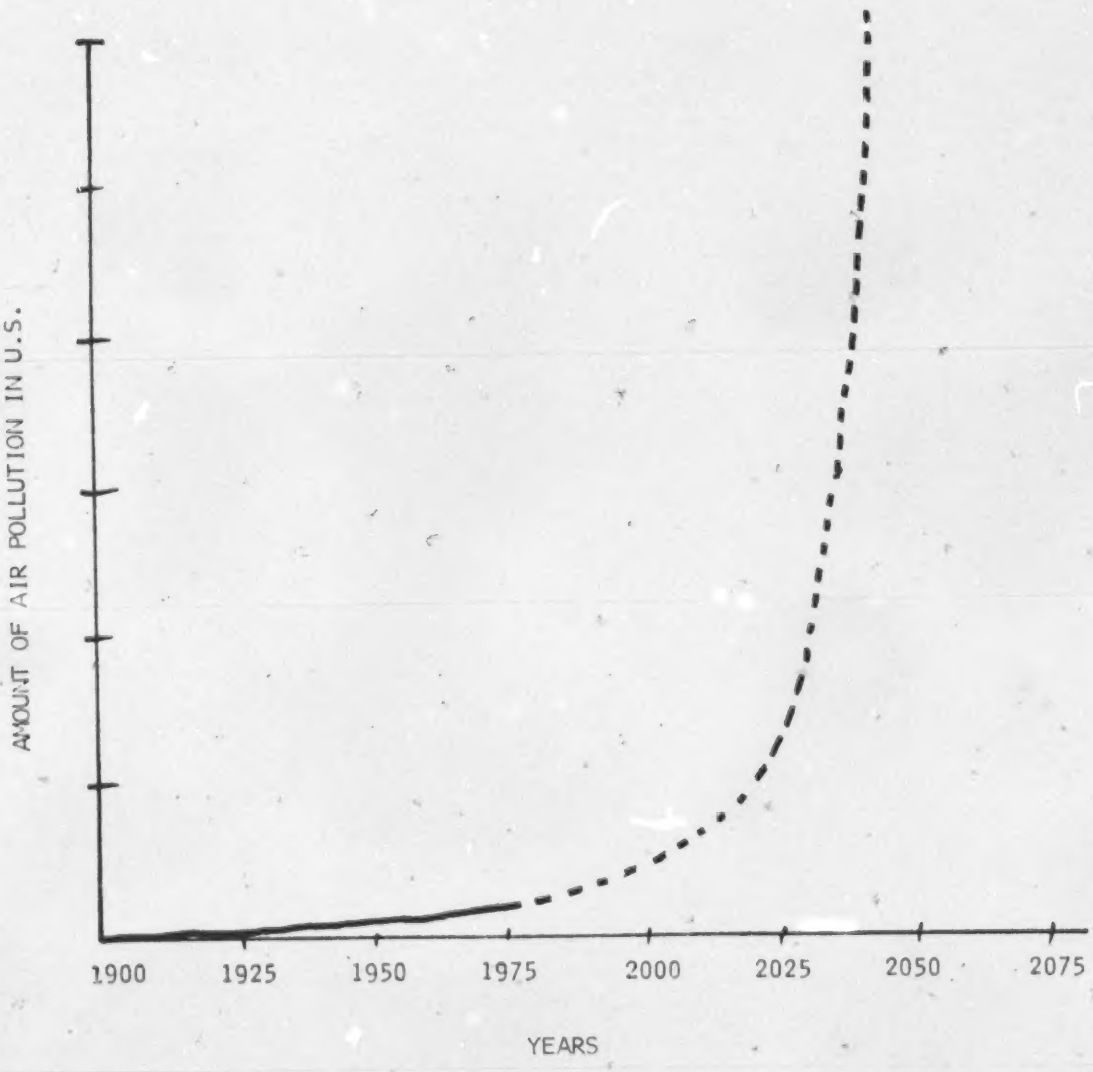
List the new ideas on the board with the old ones.

SUGGESTED EXTRA ACTIVITIES:

Have students write a "danger" list of things that could happen if pollution isn't checked.

AMOUNT OF AIR POLLUTIONS GROWTH

TRANSPARENCY 4A



LESSON 5

CONCEPT: Pollutants come from the things we use daily.

MATERIALS:
Tagboard for each student (construction paper)
Overhead and marker
Transparency 2B
Magazines to be cut up
Scissors for students
Paste
Marking pens
Copy of ditto 5 for each student

PROCEDURE: What is pollution? Develop idea of what pollution is, and kinds of pollution there are.

What is pollution? (Children should give all different kinds of answers. These should be discussed and questioned by you and other students. Once all ideas have been presented give legal definition.)

Write on overhead the legal definition of pollution is "any impairment of water, air or land quality that makes it unsuitable for beneficial use."

What is the problem with a definition like this one? (Some human polluter has to decide what is unsuitable and beneficial.)

Pollution that makes air, land or water look dirty is not the only kind of pollution. Can anyone think of what other kinds of pollution there might be? (temperature - thermal, chemical, abuse of resources, non-human)

Each one of these types of pollution is caused by us, the polluters. Let's take a look at each one of the types of pollution and find out some of the things they are caused by.

Using the ditto I have given you, fill in the spaces as we talk about each one.

In each of the above categories, there is a list of polluting agents. These should come from the student. Only if they cannot come up with them, should you fill in the blanks.

EVALUATIVE ACTIVITY: Once the list is finished, the student should use it in composing his collage on pollution. Every time he/she is able to illustrate the specific polluter he/she should circle it on the ditto. The more circled, the better the collage.

Now that we have completed the ditto, and have a list of polluters, you are going to be composing a collage that will illustrate the different kinds of specific polluters.

The idea of a collage is a colorful grouping of pictures that tell a story. Each collage should have a title which you think helps explain what you are trying to tell.

There are magazines, scissors, paste and marking pens for you to use. Use your imagination and go to it!

The teacher should help and circulate as best he can. The student should be allowed 60-90 minutes. Let them know how much time they have.

They can try to illustrate one type of pollution, all types, direct pollution, indirect pollution.

Put up all collages in classroom.

If an example of a collage is available, show it to students to give them a visual hint.

Type of Pollution	Polluting Agent	Specific Polluter
Chemical:		
Thermal:		
Misuse or Waste:		

Answer sheet for ditto 5A

Type	Polluting Agent	Specific	
Chemical	Detergents	Lux	Smoke
	Factories	Tide	Smog
		All	
		Cheer	
		Shampoos	
	Chemical wastes from factories	DDT	
Thermal	warms water when industries dump cooling water into streams	Atomic reactors	
Misuse	over irrigation	DDT runoff	
	leave taps running		
Non-Human	Nature		

LESSON 6

CONCEPT: Pollution hurts others besides the polluters themselves. Direct and indirect pollution.

MATERIALS: Film "Of Broccoli, Pelicans, Celery and Seals" (30 min.)
Projector
Overhead and marker
Pollution assignment of lesson 5

PROCEDURE: Review briefly lesson 5. Examine some of the collages that are displayed.

Yesterday we learned that people are the major polluters, either directly or indirectly.

This could be a jam session to work out definitions for how we are direct or indirect polluters.

What is the difference between direct and indirect pollution? (Answers should vary, direct: polluter uses item which in turn pollutes; indirect: polluter uses item which doesn't pollute, but whose manufacture caused pollution in the process.)

Another way of showing the difference between direct and indirect pollution is to examine our actions.

(1) When we eat an apple, and throw away the core, we are not polluting directly, because the core will decompose or rot and become part of the soil without disturbing nature.

If, however, we go back to the apples origin at the farm and see that DDT and other chemicals were used in growing the apple, we can see it as an indirect polluter.

(2) A direct polluting agent is much easier to detect. If I do the dishes and use a detergent, that detergent is going to find its way directly into the water. Therefore it is a direct pollution.

EVALUATIVE ACTIVITY: *Get out your pollution lists from lesson 5. Let's go over our specific polluters and see if they are direct or indirect polluters.*

There's a hint, direct polluters are usually ones we can see and indirect polluters tend to be a little harder to find. What do you think most of your list is going to be? (Direct)

We are now going to see a film about plants and animals hurt by pollution.

Show film.

LESSON 7

CONCEPT: Go over all of ideas covered in previous 6 lessons.
Quiz

MATERIALS: Overhead and marker
Copy of quiz for each student

PROCEDURE: This lesson is a summary in a sense, it should bring together all the terminology and concepts that have been examined in the ELE. The last two lessons are summary activities where the student will need to have all of his information on hand.

We are going to spend part of today going over some of the materials we have collected and finding out any of the new vocabulary we have learned. You are going to need all of your notes and assignments. You should also have a piece of notebook paper. After the review, you will be given a quiz.

As each topic or vocabulary word is reviewed, it should be written on the overhead and left. Below are the concepts that should be reviewed. Say each aloud to class, allow them to give the definitions, you refine them, then write on overhead.

Exponents as shorthand
The exponent zero
The power of exponents (review chess board paradox)
Pie graphs show % relations
Linear graphs, time and meas. quan.
Population growth is exponential
Doubling time
People cause pollution
Pollution grows exponentially
Prediction using exponential graphs
Exponential growth is accelerating
Direct pollution
Indirect pollution
Types of water pollution: chemical, thermal, misuse
Pollution hurts plants and animals

Give students quiz which will cover previous six lessons. Before handing it to them, about 5-8 minutes should be allowed for valid questions.

You are now going to take a short quiz concerning the materials we have talked about in our previous lessons. Do you have any questions before I hand it out?

Quiz - 10-15 minutes.

Correct quiz in class and hand back to student.

Quiz
Lesson 7

Name _____ Date _____

MATCHING:

_____ 1.	doubling time	a.	upward moving graph
_____ 2.	exponent	b.	one
_____ 3.	direct pollution	c.	visible pollution happening at once
_____ 4.	pie graph	d.	temperature
_____ 5.	exponential graph	e.	people
_____ 6.	X^0	f.	prediction
_____ 7.	chessboard paradox	g.	time it takes population to double
_____ 8.	polluters	h.	shorthand in arithmetic
_____ 9.	thermal	i.	illustration with percent
_____10.	future	j.	$1,000,000

FILL-IN:

Three different kinds of water pollution are _____, _____, and _____. Pollution grows _____ because population does, and pollution is caused by _____. Pollution you can see immediately is _____ pollution and that which is a step process of pollution is called _____. Pollution does not hurt the polluter only, it also hurts innocent _____ and _____.

SHORT ESSAY:

Write a short paragraph explaining doubling time. Give an example.

Pollution Game Questions
Lesson 8

Question	Number of moves
1. The population was 100 in 1970 and 200 in 1971. What is its doubling time? Answer 1 year	2
2. What is the value of 10^3? Answer: 1000	1

LESSON 8

CONCEPT: The construction of a pollution game using pollution and exponent questions reinforces the concepts.

MATERIALS:
Tagboard for each student
3 x 5 cards, 5 for each student
Overhead and marker
Colored marking pens
Magazines for cut outs (optional)

PROCEDURE:

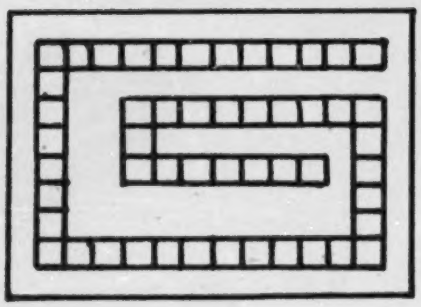
Today you are going to be using the materials you have collected in making a pollution game. It should take you all period to construct the game and cards that go with the game. Tomorrow we will be getting into groups to play the different games that everyone has made.

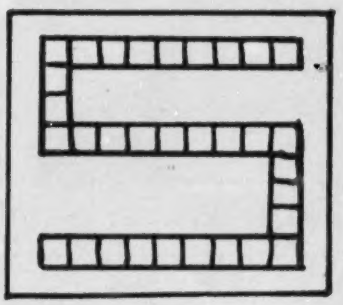
It is a good idea to make a rough draft of your game on a piece of paper before you put it on the tagboard.

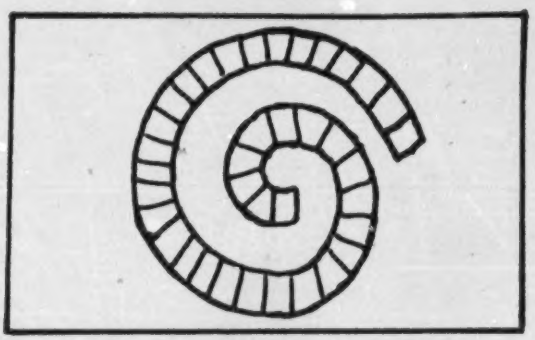
Put game transparency on overhead.

This is an example of what a game could look like. Yours should be much more colorful, because you are using marking pens.

Teacher can also put other examples of what the games could look like on the board such as below.







Game Cards: Mathematical or pollution questions that are worth a certain number of moves.

Along with the game boards, you will each be making up five questions that are either pollution or math oriented. The harder the question, the more moves it should be worth.

Give students an example of both an easy and a hard question. No question should be worth more than four moves. Use samples given in the ELE.

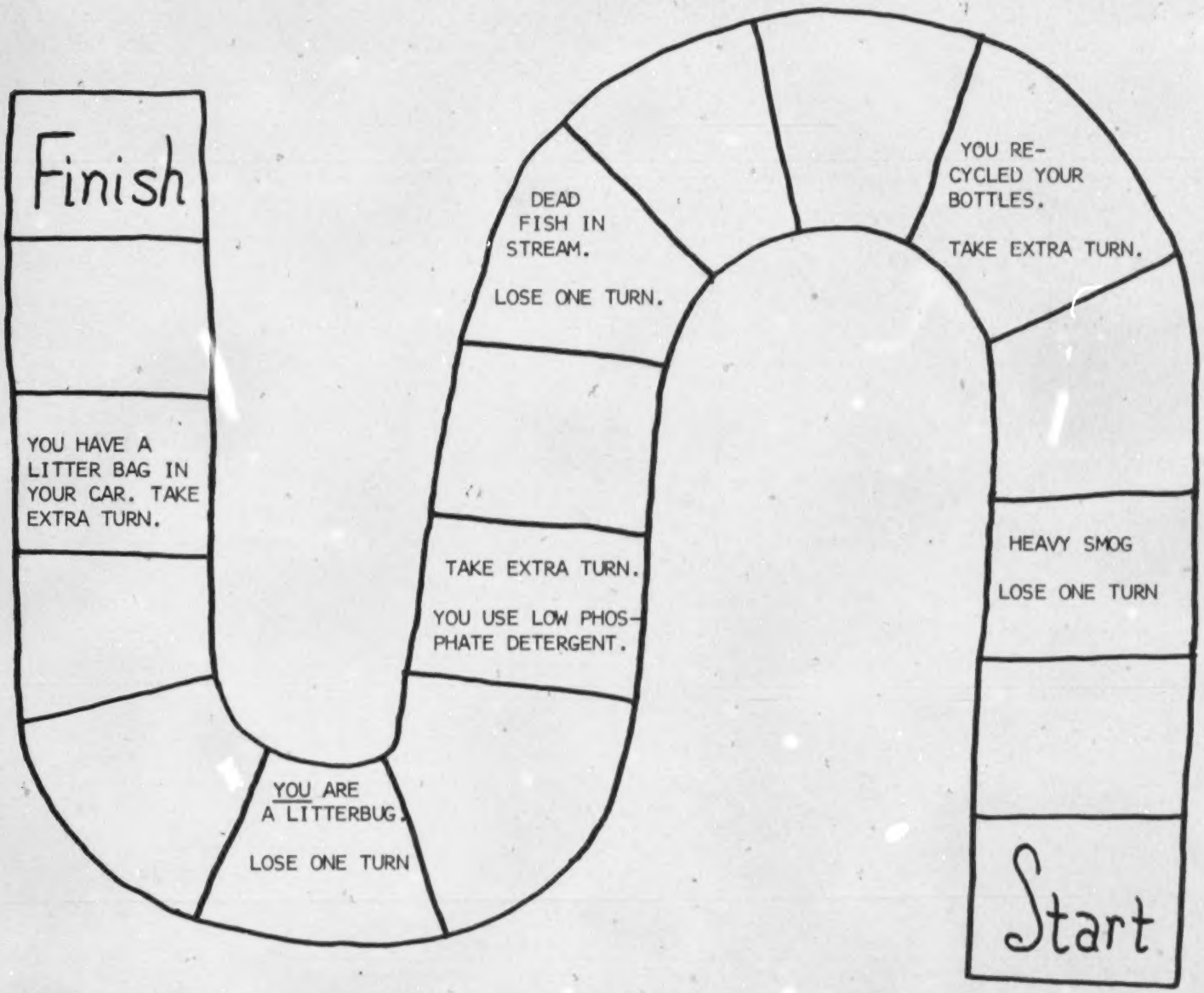
To show you what kinds of questions are possible I will give you an example of an easy and a hard question.

Use any of the questions on the question supplement.

Rules for the game are up to the individual or group. An example of one particular set of rules follows:

> *Instead of using dice or a spinner you will determine the number of spaces you move by correctly answering the question on the cards from the draw pile. If you answer correctly, move the number of times in the upper right hand corner.*
>
> *Depending on where you land you might get an extra turn, lose a turn or simply continue normal play.*

EVALUATIVE ACTIVITY: On the day the games are completed, groups should be formed and the games should be played.


Finish
YOU HAVE A LITTER BAG IN YOUR CAR. TAKE EXTRA TURN.
YOU ARE A LITTERBUG.
LOSE ONE TURN
TAKE EXTRA TURN.
YOU USE LOW PHOSPHATE DETERGENT.
DEAD FISH IN STREAM.
LOSE ONE TURN.
YOU RECYCLED YOUR BOTTLES.
TAKE EXTRA TURN.
HEAVY SMOG
LOSE ONE TURN
Start

LESSON 9

CONCEPT: We are responsible for the future of the earth. What will the future be like?

MATERIALS: Science fiction story or film "From the Face of the Earth" Overhead and marker

PROCEDURE: Tell students a science fiction story that involves some catastrophic occurance due to population or show film "From the Face of the Earth".

Analyze story by asking these three questions:

What kind of pollution caused the disaster in the story?
Did the occupants care about the event, or were they happy under the new system?
Was there a way it could have been avoided?

EVALUATIVE ACTIVITY: After this discussion the students are given an assignment of writing their own science fiction stories of something which could happen in the future.

The better stories will have some mathematic or scientific focus.

When all of the stories are completed a journal should be composed and distributed no later than two weeks after the unit is complete.

For your convenience the films used in this ELE are listed on this tear out sheet. Simply add the dates required and mail to the Instructional Material Center, ERAC.

Project ECOLogy

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